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RESEARCH ARTICLE

Disparities in Potentially Preventable Hospitalizations: Near-National Estimates for Hispanics

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Objective. To obtain near-national rates of potentially preventable hospitalization (PPH)—a marker of barriers to outpatient care access—for Hispanics; to examine their differences from other race-ethnic groups and by Hispanic national origin; and to identify key mediating factors.

Data Sources/Study Setting. Data from all-payer inpatient discharge databases for 15 states accounting for 85 percent of Hispanics nationally.

Study Design. Combining counts of inpatient discharges with census population for adults aged 18 and older, we estimated age-sex-adjusted PPH rates. We examined county-level variation in race-ethnic disparities in these rates to identify the mediating role of area-level indicators of chronic condition prevalence, socioeconomic status (SES), health care access, acculturation, and provider availability.

Principal Findings. Age-sex-adjusted PPH rates were 13 percent higher among Hispanics (1,375 per 100,000 adults) and 111 percent higher among blacks (2,578) compared to whites (1,221). Among Hispanics, these rates were relatively higher in areas with predominantly Puerto Rican and Cuban Americans than in areas with Hispanics of other nationalities. Small area variation in chronic condition prevalence and SES fully accounted for the higher rates among Hispanics, but only partially among blacks.

Conclusions. Hispanics and blacks face higher barriers to outpatient care access; the higher barriers among Hispanics (but not blacks) seem mediated by SES, lack of insurance, cost barriers, and limited provider availability.

Key Words. Hispanics, disparities, potentially preventable hospitalizations, ambulatory care sensitive condition admissions

In 2001, Hispanics became the largest minority in the United States (Clementson 2003); however, there is as yet little national evidence for Hispanics using health care utilization data. National surveys indicate that

Hispanics face high self-reported barriers to health care access (Agency for Healthcare Research & Quality 2013). Lack of health insurance, the primary access barrier, remains most prevalent among Hispanics, with 41 percent of adults aged 18–64 uninsured in 2013, compared to (non-Hispanic) blacks (25 percent) and (non-Hispanic) whites (15 percent; Kaiser Family Foundation 2016). Based on inpatient care utilization data and using potentially preventable hospitalizations (PPHs) as the marker of barriers to outpatient care access, several studies have found higher rates of barriers among Hispanics (Bindman et al. 1995; Agency for Healthcare Research & Quality 2013; Agency for Healthcare Research and Quality 2015b). Identification of hospitalizations categorized as potentially preventable has evolved over time; in recent years, a widely used categorization—also applied in our study—is AHRQ's Prevention Quality Indicators (Agency for Healthcare Research and Quality 2015b).

However, these studies were limited to local or regional analyses for Hispanics (Djojonegoro et al. 2000; Cable 2002; DeLia 2003; Basu, Thumula, and Mobley 2012); obtaining the national PPH rate has been challenging due to high rates of misclassification and incompleteness of Hispanic ethnicity data. Medicare utilization data, the principal source for a wide range of national estimates of black–white disparities, are "completely unreliable for the Hispanic population" (Arias 2010) as a large proportion—differently estimated at 8 percent (Arias 2010) and 33 percent (McBean 2004)—are misclassified, primarily as whites. The Agency for Healthcare Research and Quality's (AHRQ) all-payer National Inpatient Sample, comprised of sample data from 44 states (as of 2012), also undercounts minority populations, with over 11.4 percent of discharges found to have missing race-ethnicity (Agency for Healthcare Research & Quality 2015a). The annual National Hospital

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Discharge Survey from the Centers for Disease Control has 16 percent of discharges missing race-ethnicity information (2010; Kozak 1995).

A near-national estimate of PPH rate for Hispanics, obtained by AHRQ, and reported in the National Healthcare Disparities Report, is based on a specially developed *disparities analysis database* of 40 percent sample of hospitals from 36 states that report race-ethnicity information (Coffey et al. 2012; Agency for Healthcare Research & Quality 2013; Moy, Chang, and Barrett 2013). The overall rate of missing race-ethnicity information, prior to any exclusions, was not reported (Coffey et al. 2012); as the AHRQ disparities analysis database is not made available to other researchers, we used other sources that indicate that the missingness rates (for 2010) were high for some states included in the AHRQ near-national data file: Michigan (22.2 percent), Washington (14.2 percent), and Colorado (13.5 percent; Agency for Healthcare Research and Quality 2015d). Consequently, inclusion of such states, while increasing the national coverage, comes at the cost of higher rate of incompleteness of race-ethnicity information and greater reliance on statistical imputation. In addition, use of a sample of hospitals in this data file precludes any examination of small area variations in population PPH rates to identify the sources of disparities in these rates by race-ethnicity. To address the high rates of missingness of race-ethnicity information and to examine factors that may be associated with race-ethnic disparities in PPH rates, we developed an alternative near-national database; unlike the AHRQ disparities analysis database, which included a 40 percent sample of hospitals, we included all hospitals from the selected states.

Our study had multiple objectives. First, we aimed to estimate near-national PPH rates for Hispanics. In developing the alternative database, we capitalized on the concentration of Hispanic population in a relatively small number of states, and the nearly complete reporting of race-ethnicity information in inpatient discharge databases from almost all these states (Ennis, Rios-Vargas, and Albert 2011; Agency for Healthcare Research and Quality 2015d). We identified 15 states that together accounted for 85 percent of the national adult Hispanic population (2010) and in which race-ethnicity was missing for only 1.3 percent of all discharges. Our choice of 15 states was motivated by balancing the twin goals of maximizing generalizability to the national Hispanic population and optimizing internal validity by minimizing the rate of missing race-ethnicity. Using this database, we estimated PPH rates for Hispanics, and their differences from that for non-Hispanic black and non-Hispanic white residents of the same states.

Our second objective was to examine the role of potential mediators of race-ethnic disparities in PPH rates, focusing on factors identified in previous studies (DeLia 2003; Hadley and Cunningham 2004; Vargas et al. 2004; Basu, Thumula, and Mobley 2012), including prevalence of chronic conditions, SES, lack of insurance, cost barriers, acculturation, provider availability, and rural/urban location. An advantage of our database, over that developed by AHRQ, is that it includes *all* nonfederal short-term acute hospitals and discharges, and thus permits analysis of small area variations in the aforementioned factors; the AHRQ disparities analysis database is based on 40 percent sample of the nonfederal short-term acute hospitals.

Hispanics are heterogeneous with differences across subgroups in "sociocultural practices, environmental experiences, genetic backgrounds, and cultural histories that shape their predispositions to certain chronic conditions" (Rodriguez et al. 2014). An important source of distinction is by national origin, with evidence indicating relatively higher risk profile—measured in terms of prevalence with one or more cardiovascular risk factors, including smoking, obesity, and hypertension—among Puerto Rican and Cuban Americans, compared to Mexican and other Hispanics (Daviglus et al. 2012). Using census small area data on national origin of Hispanics, our third objective was to examine differences among Hispanics by national origin in potentially preventable hospitalization rates (Ennis, Rios-Vargas, and Albert 2011; Daviglus et al. 2012).

Using the new database, we tested the null hypotheses that PPH rate, adjusted for differences in demographic composition and prevalence of chronic conditions: (1) is higher among Hispanics compared to non-Hispanic whites; (2) differs across Hispanics by national origin; and (3) is greater in areas with more uninsured population, lower income, higher cost barriers, lower provider availability, and smaller/rural population.

METHODS

Data Sources

Our primary data source was inpatient discharge data, covering all patient discharges at all nonfederal short-term acute hospitals, from 15 states for 2010 and 2011. These states—Arizona, California, Colorado, Florida, Illinois, Massachusetts, Maryland, Nevada, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Texas, and Virginia—were identified based on the relative share of the national adult Hispanic population (aged 18 and older),

completeness of patient race-ethnicity data, and availability of comprehensive inpatient administrative data; see Appendix A for details on the selection, completeness of race-ethnicity data, and exclusions. These 15 states are among the top 20 states by share of Hispanic population; data from the other five states had race-ethnicity missing in over 13 percent of discharges or data could not be acquired. Among the selected 15 states, the overall rate of missing race-ethnicity was 1.3 percent, with the highest rate of 10.2 percent in Oregon. Data for California, Texas, Illinois, Pennsylvania, Massachusetts, and Virginia were obtained from the respective state agencies (Agency for Healthcare Research and Quality 2015c), and data for remaining states were obtained from AHRQ HCUP Central Distributor (Agency for Healthcare Research and Quality 2015e).

We applied several exclusion criteria on the overall discharges for adults 18 and older, as summarized below; see Appendix A for more details. First, for parity in comparison across states, and following AHRQ methodology, we only included discharges from community hospitals, resulting in exclusion of 1.3 percent discharges from noncommunity hospitals (e.g., long-term care, and psychiatric and rehabilitative hospitals; Coffey et al. 2012). Second, we excluded 3.9 percent of hospitals (containing 1.7 percent of discharges) because the race-ethnicity information from the hospitals met the AHRQ methodology criteria of implausibility (Coffey et al. 2012). Third, we excluded 0.7 percent discharges with missing key measures. Fourth, we excluded 3.0 percent discharges for out-of-state residents so as to calculate PPH rates based on resident census population.

We obtained data on the census population of resident adults for 2010 and 2011 stratified by age, sex, and race-ethnicity aggregated at county and state levels (U.S. Census Bureau 2015b). We also obtained county-level data from the 2010 Census on the composition of Hispanic population by national origin that identified the following four groups: Mexican, Puerto Rican, Cuban, and Other Hispanic (Health Resources and Services Administration 2015). We used Behavioral Risk Factor Surveillance System (BRFSS) 2011 data on prevalence of chronic conditions, health care access, and socioeconomic indicators (Centers for Disease Control and Prevention 2016). We obtained data on socioeconomic indicators from the Census Bureau and data on acculturation indicators from the American Community Survey (2011 estimates based on survey data from 2007 to 2011; U.S. Census Bureau 2015a). We used 2010 data on provider availability (from the Area Health Resource File (AHRF; Health Resources and Services Administration 2015). We used rural/urban categorization based on population size and proximity to

metropolitan areas from the US Department of Agriculture, as another indicator of proximity to providers (US Department of Agriculture 2006).

Race-Ethnicity

After the aforementioned exclusions, 1.1 percent of the remaining discharges were missing race-ethnicity information. We grouped the nonmissing discharges into four categories: Hispanic, non-Hispanic black, non-Hispanic white, and Others, with the latter category primarily comprising of Asians/Pacific Islanders and Native Americans. As there may be systematic differences across hospitals in rate of missing race-ethnicity (Andrews 2015), we followed AHRQ methodology and assigned these discharges to one of the four race-ethnicity categories based on statistical imputation ("hot-deck") after stratifying patients by hospital (Coffey et al. 2012). This approach randomly assigns the discharges with missing race-ethnicity from each hospital to one of the four race-ethnic groups (Hispanics, blacks, whites, or Others) in the same proportion as observed among discharges from that hospital with reported race-ethnicity. As a sensitivity analysis for the influence of race-ethnicity imputation, we also obtained estimates of race-ethnic differences in PPH rates by treating all discharges with missing race-ethnicity as either (1) white or (2) non-white.

Potentially Preventable Hospitalizations

We identified inpatient admissions for adults aged 18 and older with the principal diagnosis of one of following 12 conditions in accordance with the AHRQ Prevention Quality Indicators (PQI) Version 4.5 protocol to identify PPHs (Agency for Healthcare Research and Quality 2015b): diabetes with short-term complications, diabetes with long-term complications, chronic obstructive pulmonary disease or asthma in older adults (age 40 and older), hypertension, heart failure, dehydration, bacterial pneumonia, urinary tract infection, angina without procedure, uncontrolled diabetes, asthma in younger adults (age 18–39), lower extremity amputation for patients with diabetes. These hospitalizations are also referred to as ambulatory care sensitive condition (ACSC) admissions (Agency for Healthcare Research and Quality 2015b).

Analytic Data and Measures

We performed two sets of analyses, one to obtain age-sex-adjusted PPH rates and another to examine small area variations in the PPH rate; accordingly, we

developed two analytic datasets. For the first, we treated a state as the unit of observation and stratified each of the 15 states into 24 demographic cohorts by sex, age (18–44, 45–64, and 65+), and race-ethnicity (Hispanics, blacks, whites, and Others), leading to a total of 360 state-cohort observations. We obtained the aggregate count of PPHs for each state-cohort observation using the discharge data and the overall population count from the Census data; these two were the primary measures for obtaining population-level PPH rates. As secondary measures, we also obtained PPH rate by medical condition grouped as chronic (diabetes, COPD/asthma, hypertension, CHF/angina, and lower extremity amputation among patients with diabetes) and acute (dehydration, bacterial pneumonia, and urinary tract infection).

To examine small area variations in the PPH rate, we developed a second dataset by aggregating counts of PPHs and census population at the county level (using patients' county location). Of the 966 counties from the 15 study states, we identified the 60 counties with small census population (<1,000) and combined each with the largest county in the respective state, as this is likely to have marginal impact on the estimated PPH rates; in no county did the combined population increase by more than 0.03 percent. The resulting 906 counties were stratified by the same 24 demographic cohorts (sex, age, and race-ethnicity), leading to a potential dataset of 21,744 county-cohort observations. Of these, 934 (4.3 percent) had zero census population (all for minority groups) and were excluded, leading to a final analytic data of 20,810 county-cohort observations; see below for sensitivity analysis relating to this exclusion. Using county-level data on composition of Hispanic population by national origin, we grouped all counties into areas based on the largest origin group: Mexican, Puerto Rican, Cuban, and Other Hispanic.

To estimate adjusted differences by race-ethnicity in PHH rates, we used area-level covariates covering five domains: clinical risk, SES, health care access, acculturation, and provider availability (DeLia 2003; Hadley and Cunningham 2004; Vargas et al. 2004; Basu, Thumula, and Mobley 2012). To adjust for variations in prevalence of clinical risk factors, we used individual-level BRFSS 2011 data from the 15 study states on prevalence of five risk indicators (hypertension, high cholesterol, diabetes, coronary heart disease, and COPD/asthma) and produced aggregate prevalence rate of each indicator for the aforementioned age–sex–race–ethnicity demographic cohorts ($N = 24$) by state; the top half of the cohorts by prevalence in each state were categorized as having "high" prevalence and the remaining cohorts as having "low" prevalence. We used prevalence rate for cohorts at state level rather than

county level due to modest BRFSS sample sizes for many counties across most states, particularly for minority racial-ethnic cohorts.

We obtained data on four SES measures. Three measures—median household income, percent of working-age population unemployed, and percent households in poverty—were obtained from the Census Bureau and represented aggregate indicators for cohorts by age, sex, and race-ethnicity at the county level; the top/bottom half of the cohorts in each state were categorized as high/low prevalence categories. In addition, we obtained data on the proportion of population aged 25 and older who did not complete high school education from BRFSS for the same state-level demographic cohorts.

Using BRFSS data, we produced three measures of health care access—percent uninsured, percent without a personal ("regular") physician, and percent who did not see physician due to cost in the previous year—for state-level demographic cohorts and grouped the top/bottom half into high/low categories. Using county-level data from the American Community Survey, we use three measures of acculturation: percent population whose language spoken at home is not English, percent population who speak English "less than very well," and percent of foreign-born population. For each measure, counties in each state were grouped into high and low categories using the median as the cutoff. We obtained two measures of physician availability and proximity. From the Area Health Resource File we obtained county-level measure of the number of primary care physicians available per 1,000 population in 2010 and categorized the counties the top/bottom half of counties into high/low availability categories. Based on population size and rural or urban location, we grouped counties into four categories: large urban (population more than 250,000), moderate urban (20,000 to 250,000), small urban (less than 20,000 and near metropolitan areas), and rural (not near metropolitan areas; US Department of Agriculture 2006).

Analysis: PPH Rates

We estimated the population PPH rate per 100,000 census population, adjusted for compositional differences by sex and age using the direct standardization method and the state-cohort analytic data (Woodward 2005). This was estimated, along with its 95 percent confidence interval, for the pooled population from 15 states, and by race-ethnic groups. We also estimated relative differences in Hispanic–white and black–white rates using incidence rate ratios, estimated from Poisson regression models of PPH counts using age, sex, state (fixed effect), and census population (exposure) as covariates. Using

similar methods, we estimated PPH rates for each ambulatory care sensitive medical condition. We also obtained rates for subgroups of the population based on state and areas by largest Hispanic national origin group.

Analysis: Sources of Disparities in PPH Rates

To explore mediators of variation in PPH rates by race-ethnicity, we used county-level data and estimated a Poisson regression model of PPH counts adjusting for covariates relating to clinical risk, SES, health care access, acculturation, and provider availability. In addition, we adjusted for unobserved state-level differences using a fixed effects specification; standard errors were adjusted for clustering of cohorts at the state level (DeLia 2003; Cameron and Trivedi 2005). To assess the relative role of the five covariate domains, we estimated a sequence of the aforementioned Poisson model, incrementally adding measures from each domain sequentially.

Sensitivity Analysis

We performed several analyses of the sensitivity of our main findings. First, as noted earlier, we used an alternative grouping of the 1.1 percent discharges with missing race-ethnicity, by treating them all as either (1) white or (2) non-white. In the latter case, discharges with missing race-ethnicity from each hospital were randomly assigned as Hispanics, blacks, or Others in the same proportion as observed among discharges from that hospital with reported non-white race-ethnicity. Our objective was to examine the sensitivity of the estimates of PPH rates by race-ethnicity to extreme assignment of missing discharges as either all white or non-white. Second, development of the county-level analytic data resulted in 4.3 percent of county-cohort observations being excluded for having zero census population, all for nonminority groups, leading to unbalanced numbers of observations from different counties. To ascertain the robustness of the adjusted estimates race-ethnicity differences in PPH rates, we re-estimated the Poisson regression models treating county as fixed effects (dichotomous indicator) and thereby limiting race-ethnicity comparisons to those within county (Cameron and Trivedi 1998). Third, counties grouped based on the national origin of Hispanics, we examined the impact on findings from an alternative grouping wherein a county was categorized to a national origin group (Mexican, Puerto Rican, or Cuban) only if at least 50 percent of Hispanics in the county were of this national origin group, instead of being in the majority; counties where no national origin group represented

at least 50 percent of Hispanics were categorized as "Mixed." Finally, to better inform the discussion of findings, we examined individual-level BRFSS data to assess racial/ethnic differences in the clinical risk factors included in the main analysis.

RESULTS

Of the national population of 33.3 million Hispanic adults aged 18 years and over in the 2010 Census, 85 percent resided in the 15 study states; in contrast, the corresponding share was 53 percent for (non-Hispanic) blacks and 50 percent for (non-Hispanic) whites, and 57 percent of the national population (Table 1). Overall, Hispanics and blacks accounted for 21.2 and 11.1 percent of the overall population in the study states, respectively. Of the 3.75 million PPHs identified in the study states, Hispanics and blacks accounted for 13.5 and 17.3 percent, respectively (Table A10 in Appendix A). Adjusted for age and sex, the PPH rate for Hispanics (1,375) and blacks (2,578) was 13 and 111 percent, respectively, higher than that for whites (1,221). There were distinct regional differences in white-Hispanic differences in PPH rates: Rates for Hispanics were significantly lower than that for whites in five states (Maryland, Nevada, New Jersey, Oregon, and Virginia,), and significantly higher in seven (California, Florida, Illinois, Massachusetts, New York, Pennsylvania, and Texas), and similar in the remaining five (Arizona, Colorado, and New Mexico). Rates for blacks were higher than for whites (and Hispanics) in all the states.

Racial/ethnic differences in PPH rates varied across the individual conditions (Table 2). While chronic conditions, comprising mainly of congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD)/asthma, and diabetes, accounted for 59 percent of overall PPHs among whites, this proportion was substantially higher among blacks (74 percent) and Hispanics (64 percent). PPHs from acute conditions, primarily pneumonia and urinary tract infection, were similar among Hispanics and 34 percent higher among blacks, compared to whites. Across all 16 conditions that constitute PPHs, rates for blacks were higher than for Hispanics and whites.

Differences by race-ethnicity in PPH rates were larger among those 65 and older, than those younger than 65 (Table B1 in Appendix B). Relative to whites, the rates for Hispanics were 15 percent higher among the 65 and older, and 8 percent higher among those younger than 65. In both age groups, the differences were primarily due to differences for chronic PPH conditions.

Table 1: Census Population and Crude Potentially Preventable Hospitalizations Rates in Study States, by Race-Ethnicity Ages 18+; 2010–2011

	State Share (%) of National Census Population of Adults Aged 18+, by Race-Ethnicity, 2010				*Age-Sex Rate of Potentially Preventable Hospitalizations = # PPH/100,000*			
State	*% of National Hispanic Population*	*% of National Non-Hispanic Black Population*	*% of National Non-Hispanic White Population*	*% of National Population*	*Hispanic*	*Blacks, Non-Hispanic*	*Whites, Non-Hispanic*	*All*
CA	27.8%	6.1%	7.9%	11.9%	1,227	2,403	1,052	1,063
TX	18.4%	7.6%	5.8%	7.8%	1,480	2,432	1,413	1,373
FL	9.4%	7.6%	5.8%	6.3%	1,543	2,777	1,430	1,816
NY	7.3%	8.2%	5.8%	6.4%	1,654	2,252	1,190	1,434
IL	3.9%	4.8%	4.1%	4.1%	1,702	3,219	1,328	1,586
AZ	3.6%	0.7%	1.9%	2.0%	1,281	2,667	1,306	1,339
NJ	3.3%	3.1%	2.6%	2.9%	938	2,552	1,347	1,583
CO	2.0%	0.5%	1.8%	1.6%	832	1,745	883	837
NM	2.0%	0.1%	0.4%	0.7%	1,627	2,904	1,326	1,001
NV	1.4%	0.6%	0.8%	0.9%	976	1,459	969	1,233
PA	1.4%	3.5%	5.2%	4.2%	1,680	3,292	1,475	1,847
VA	1.3%	4.1%	2.6%	2.6%	740	2,481	1,405	1,355
MA	1.2%	1.1%	2.6%	2.2%	701	2,428	1,345	1,682
MD	1.0%	4.5%	1.6%	1.9%	2,130	2,408	1,492	1,551
OR	0.8%	0.2%	1.5%	1.3%	633	1,715	817	880
Total	84.6%	52.6%	50.5%	56.8%	1,375	2,578	1,221	1,408
N, all 15 states	28,219,399	14,772,505	79,263,390	133,233,303	508,491	649,013	2,424,988	3,752,766
N, United States	33,346,703	28,088,003	157,100,990	234,564,070	Not available			

Notes. The findings were produced using state-level aggregated data by race/ethnicity. Data sources: Census population data (2010–2011) were obtained from the Census Bureau, and counts of potentially preventable hospitalizations were obtained from the inpatient discharge data (2010–2011) from the study states. Potentially preventable hospitalization rates were calculated as annual rates using data from 2010 and 2011.

Table 2: Age-Sex-Adjusted Potentially Preventable Hospitalization Rates (#/100,000) by Race-Ethnicity

	Hispanics		*Blacks, Non-Hispanic*		
	Average Rate	*% Higher (+)/ Lower (−) Than for Whites*	*Average Rate*	*% Higher (+)/ Lower (−) Than for Whites*	*Whites, Non-Hispanic Average Rate*
All ACSCs	1,375	13%	2,578	111%	1,221
Chronic ACSCs	879	23%	1,912	167%	715
Diabetes	242	70%	497	250%	142
COPD/asthma	220	−14%	481	87%	257
Hypertension	64	83%	200	471%	35
CHF/angina without procedure	330	22%	693	157%	270
Lower extremity amputation among patients with diabetes	24	140%	40	300%	10
Acute ACSCs	507	−1%	683	34%	511
Dehydration	85	−20%	156	47%	106
Bacterial pneumonia	227	−7%	293	20%	245
Urinary tract infection	195	22%	234	46%	160

Notes. The findings were produced using state-level aggregated data stratified by age (grouped into 18–44, 45–64, and 65+), sex, and race/ethnicity. Data sources: Census population data (2010–2011) were obtained from the Census Bureau, and counts of potentially preventable hospitalizations were obtained from the inpatient discharge data (2010–2011) from the study states. Age-sex-adjusted potentially preventable hospitalization rates were calculated by direct standardization. Since standard errors of all ACSC rate estimates are small (<2 in all cases), we have not reported the confidence intervals. Estimates of % higher/lower potentially preventable hospitalization rates for Hispanics and blacks relative to whites are statistically significant ($p < .05$) for all individual conditions except for asthma in younger adults.

Of the 966 counties in the study states, Hispanics of Mexican origin were in the plurality (among Hispanics) in 717 counties, and those of Puerto Rican origin in 104 counties and of Cuban origin in two counties (in Florida; Table 3). In counties where Hispanics of Mexican origin were in plurality, PPH rates were similar between Hispanics and whites; but in the counties where Puerto Rican and Cuban Americans were in plurality, the rates were significantly higher among Hispanics. The same pattern was found using an alternate grouping wherein a county's Hispanic national origin was designated only if it contained at least 50 percent of Hispanics from the same national origin (Table B2 in Appendix B).

Adjusting for area- and cohort-level differences in clinical risk, SES, health care access, acculturation, and provider availability fully mitigated the higher PPH rates among Hispanics relative to whites; the incidence rate ratio

Table 3: Age-Sex-Adjusted Potentially Preventable Hospitalization Rates by Hispanics by National Origin

National Origin of Hispanic Population	*No. of Counties in Which Each National Origin Cohort Had Plurality across Hispanic Cohorts*	*Age-Sex-Adjusted Potentially Preventable Hospitalization Rates (#/100,000) [95% Confidence Interval]*			*Incidence Rate Ratio Compared to Whites, Non-Hispanic [95% Confidence Interval]*	
		Hispanics	*Blacks, Non-Hispanic*	*Whites, Non-Hispanic*	*Hispanics*	*Blacks, Non-Hispanic*
Mexican	717	1,252	2,568	1,201	1.04 [0.97, 1.12]	2.16 [1.89, 2.46]
Puerto Rican	104	1,790	3,041	1,535	1.20 [1.01, 1.44]	2.11 [1.81, 2.46]
Cuban	2	1,745	3,068	1,528	1.15 [1.04, 1.27]	2.17 [1.89, 2.50]
All others	143	1,468	2,496	1,299	1.16 [0.92, 1.47]	2.09 [1.95, 2.23]

Notes. The findings were produced using county-level aggregated data stratified by age (grouped into 18–44, 45–64, and 65+), sex, and race/ethnicity. Data sources: Census population data (2010–2011) were obtained from the Census Bureau, and counts of potentially preventable hospitalizations were obtained from the inpatient discharge data (2010–2011) from the study states. To clarify, we produced county-level aggregated counts of potentially preventable hospitalizations and census population stratified by age, sex, and race/ethnicity (Hispanics, non-Hispanic blacks, and non-Hispanic whites). We used data on national origin of the Hispanic population in each county to stratify counties. For instance, there were 717 counties where a plurality of Hispanics were of Mexican origin; we obtained the reported estimates by separately analyzing the data from these 717 counties, without distinguishing the Hispanics within these counties by national origin. Similarly, we performed separately analysis for counties stratified by the national origin of plurality of Hispanics. Age–sex–adjusted potentially preventable hospitalization rates were obtained by direct standardization. To obtain relative rates of Hispanic–white and black–white differences, we estimated separate Poisson regression models for counties grouped by the Hispanic national origin group that was in majority, using as covariates, sex, age, and race-ethnicity; we specified state-level fixed effects to capture unobserved state factors, except for the model for Cuban origin cohort as both the counties with plurality were in the same state (Florida).

(IRR) for Hispanics was lower than 1.0 for chronic (0.80), acute (0.70), and all (0.74) PPHs (Table 4). Measures from all domains except acculturation were significantly associated with higher PHH risk. Among the clinical risk factors, higher PPH rates were associated with areas with higher rates of hypertension (IRR=1.12, relative to low hypertension areas) and diabetes (1.06); in the study population, both conditions were more prevalent among blacks, while diabetes was more prevalent among Hispanics, relative to whites (Table B3 in Appendix B). Among the other risk domains, IRR was greater than 1.0 for area cohorts with high poverty (1.14, relative to low-poverty areas), low median income (1.12), and high proportion of population who did not seek care due to cost (1.12). We found that the domains which mitigated the largest racial/ethnic differences were SES indicators and clinical risk; addition of other measures caused no sizable change in PPH risk by race-ethnicity (Table B4 in Appendix B). Measures from all domains accounted for only a portion of the black–white disparities in PPH risk, leaving a large residual difference in PPH rate among blacks (IRR = 1.39). The main estimates of differences by race-ethnicity were robust to sensitivity analyses for unobserved county differences and unbalanced panel lengths and race-ethnicity imputation approach (Tables B5 and B6 in Appendix B).

DISCUSSION

Using a database created by pooling the universe of inpatient discharge records from 15 states that together account for 85 percent of the U.S. Hispanic population, we found that the age-sex-adjusted PPH rate among Hispanics and blacks was 13 and 111 percent higher, respectively, than among whites. The higher rate for Hispanics was completely mitigated once we accounted for area- and cohort-level differences in clinical risk, SES, health care access, and provider availability; however, these differences only partially mitigated the higher rate for blacks. We found that areas where Hispanics of Puerto Rican and Cuban origin were in the plurality experienced higher PPH rates, relative to whites, than in areas where Hispanics of Mexican origin were in the majority.

Higher PPH rates may arise from barriers to prompt and good-quality outpatient care. Our finding of higher PPH rates among Hispanics and blacks, adjusted for clinical risk factors, is consistent with evidence of potentially higher barriers to care. Direct barriers to care—high rate of uninsured and high proportion who did not see physician due to cost—were independently associated with higher PPH risk. Multiple measures of low SES—low income, high poverty,

Table 4: Factors Associated with Disparities in Potentially Preventable Hospitalizations: Incidence Rate Ratio Estimates

	All Conditions	*Chronic Conditions*	*Acute Conditions*
Race-ethnicity (Reference=Whites)			
Hispanics	0.74*	0.80*	0.70*
Blacks	1.39*	1.68*	0.98
Others	0.68*	0.71*	0.66*
Hispanic national origin (Reference=Mexican)			
Puerto Rican	1.06*	1.06	1.06*
Cuban	1.44*	1.38*	1.53*
Other	1.01	1	1.02
Women	1.07*	0.94*	1.30*
Age (Reference: 18–44)			
45–64	3.49*	4.39*	2.35*
65+	13.21*	14.90*	11.50*
Prevalence			
High % hypertension	1.12*	1.11*	1.05
High % high cholesterol	0.98	0.97	1.02
High % diabetes	1.06*	1.05*	1.05*
High % coronary heart disease	1.05	1.06	1.04
High % COPD or asthma	1.02	1.03	0.99
Socioeconomic indicators			
Low income	1.12*	1.15*	1.08*
High poverty	1.14*	1.16*	1.10*
Low education achievement	1.01	0.99	1.02
High unemployment	1.07*	1.10*	1.02
Health care access			
High uninsurance	1.10*	1.17*	0.95
High % without personal physician	0.98	0.96	0.98
High % did not see physician due to cost	1.12*	1.10*	1.15*
Less than 0.65 physicians per 1,000 population (Reference: > 0.65 physicians per 1,000 population)	1.05*	1.06*	1.04*
Acculturation			
High % speak non-English at home	0.98	0.98	0.98
High % speak English less than very well	1.01	1.01	1.01
High % foreign born	1.00	1.01	0.98
Urban/rural (Reference: Metropolitan areas with population >250,000)			
Urban areas with population 20,000 to 250,000	0.94*	0.92*	0.97*
Urban areas with population under 20,000 near metro	0.98	0.92*	1.08*
Rural areas with population under 10,000	0.86*	0.80*	0.97

Notes. The findings were produced using county-level aggregated data stratified by age (grouped into 18–44, 45–64, and 65+), sex, and race/ethnicity. Data sources: Census population data (2010–2011) were obtained from the Census Bureau, and counts of potentially preventable hospitalizations were obtained from the inpatient discharge data (2010–2011) from the study states. Area-level measures of comorbidities, health care access, socioeconomic status, and provider availability were obtained from different public sources noted in the Methods section. Incidence rate ratio estimates were obtained from a Poisson regression model with the indicated reference groups. In addition to the covariates indicated, we also included indicators of individual states to adjust for unobserved systematic differences by state.

* indicates $p < .05$.

and high unemployment—were associated with higher PPH, suggesting that a single area-level measure may not adequately capture socioeconomic deprivation; for instance, median income alone may be inadequate indicator of deprivation in counties with skewed income distribution such that prevalence of median income and poverty is high. In addition, low primary care physician availability was also independently associated with higher PPH.

Disparities in prevalence of chronic disease among Hispanics were associated with disparities in PPH rates, but only partly. Of the five chronic conditions examined in our 15 study states, only one (diabetes) was more prevalent among Hispanics relative to whites while two conditions (high low-density lipoprotein cholesterol and COPD/asthma) were less prevalent and two others (hypertension and coronary heart disease) were similar in prevalence (Table B3 in Appendix B). This mixed evidence of chronic disease prevalence is consistent with findings from previous studies, which also indicated higher prevalence among Hispanics of overweight/obesity and inadequate physical activity, but lower rates of smoking (Writing Group Members et al. 2012). However, Hispanics may have higher prevalence of multiple co-occurring risk factors; in addition, prevalence of undiagnosed health risk and uncontrolled chronic disease is relatively higher among Hispanics (Writing Group Members et al. 2012).

While observed PPH rate was 13 percent higher among Hispanics compared to that for whites, we found that adjusting for differences in clinical risk, health care access, SES, and provider availability not only mitigated the difference but resulted in an adjusted PPH rate that was 26 percent lower than among whites. Given the overwhelming relative disadvantage among Hispanics across all indicators of SES and health care access, and with no distinct advantage in clinical risk profile, this finding of lower adjusted PPH rate mirrors the pattern, labeled "Hispanic paradox," of favorable mortality rates among Hispanics (Rodriguez et al. 2014). Although there is no consensus explanation for the Hispanic paradox, a recent perspective attributes it to favorable psychosocial factors (Almeida et al. 2009), including "social support, optimism, and strong familial and social ties among Hispanics, all of which are thought to be stress buffering and potentially protective among Hispanics despite their higher risk profile"(Rodriguez et al. 2014). If confirmed, this advantage among Hispanics may also confer better support among those at risk of PPHs, particularly in reducing the risk of complications of chronic conditions.

To examine heterogeneity in PPH rate across Hispanics by national origin, we identified counties based on the plurality of the national origin subgroup and found that adjusted PPH rate was 6 percent higher in counties with

a plurality of Puerto Rican Americans, compared to that in the 717 counties with a plurality of Mexican Americans; and in the two counties (in Florida) with a plurality of Cuban Americans, PPH rate was 44 percent higher. This pattern is unlikely to be driven by poor socioeconomic status since Cuban and Puerto Rican Americans have higher socioeconomic status (income and education) than Mexican Americans (Rodriguez et al. 2014). The higher PPH rate among Puerto Rican and Cuban Americans is likely associated with higher rates of acculturation in these groups; higher rates of acculturation are associated with unfavorable health behaviors and risk factors, such as poor diet and smoking (Wolff and Portis 1995; Berry 2003). In addition, prevalence of three or more co-occurring chronic conditions was highest among Puerto Rican Americans (Daviglus et al. 2012).

Based on our findings, the implementation of the Affordable Care Act of 2010 is expected to have potentially large expansion in insurance coverage, and reductions in PPH, among Hispanics and blacks. In 2013, the year preceding the coverage expansion, the proportion of the working-age population (aged 18–64) without health insurance was larger among Hispanics (41 percent) and blacks (25 percent) than whites (15 percent; Kaiser Family Foundation 2016). Evidence, following the first year of expansions (2014), indicates that one-third of those who gained insurance were Hispanics, although they accounted for only 17 percent of the population (Tavernise and Gebeloff 2016). While evidence of the impact of previous expansions on PPH is mixed (Miller 2012; McCormick et al. 2015), none of the previous expansions have matched the scale of ACA expansion. In spite of ACA reform, large coverage gaps remain, particularly among undocumented aliens (11 million) and residents of 19 states that have not expanded Medicaid coverage (3 million); a majority of these groups consists of Hispanics (Garfield and Damico 2016; Tavernise and Gebeloff 2016).

In comparing the findings for Hispanics and blacks, area-level clinical risk, SES, health care access, and provider availability only partially mitigated the black–white gap in PPH rate. However, the gap for blacks (111 percent higher rate relative to whites) is much larger than for Hispanics (13 percent higher); as such, the magnitude of mitigation of PPH rate from the aforementioned factors is larger for blacks than for Hispanics. Interventions to improve access (ACA expansion) can potentially reduce PPH gaps for blacks and Hispanics.

Our study also demonstrated an alternative approach to obtaining national estimates for Hispanics. As noted earlier, the disparities analysis file, developed by AHRQ, includes a much larger number of states (36) than our

data based on 15 states. Recognizing that the AHRQ database was designed for study of many minority groups, we note that most of the additional states in the AHRQ database modestly increase the coverage of Hispanic population but may increase disproportionately the discharges with missing race-ethnicity information (Coffey et al. 2012; Moy, Chang, and Barrett 2013). Despite these potential differences, the overall estimates of PPH rates from the two sources differed modestly. While the AHRQ data gave an estimate of 1,480 PPHs per 100,000 population for Hispanics (in 2010), the corresponding figure from our data was 7 percent lower (1,375); as the AHRQ findings were only presented graphically, the reported figure is an approximation. The AHRQ rates for blacks (2,500) and whites (1,200) were also similar to our estimates (blacks = 2,578 and whites = 1,221). As the AHRQ disparities analysis file is proprietary, access is limited. Another advantage of our approach, due to the use of 100 percent of discharges, is the ability to perform small area variations analysis to examine the sources underlying disparities in PPH rates.

Limitations

There are several limitations in our approach. First, our study population from 15 states does not account for 15 percent of Hispanic adults in the United States, in particular from the South (Georgia, Mississippi, Alabama, North Carolina, and South Carolina), which excludes a sizable proportion of the national population of blacks. As more complete information on race-ethnicity becomes available for the other states, more states can be included. Second, accuracy of race-ethnicity information in the state discharge is unknown (Geppert et al. 2004). Studies using convenience, but population-representative, sample data indicate systematic misreporting of race/ethnicity, with some suggesting systematic misclassification of Hispanics as non-Hispanic whites (McBean 2004); this suggests that PPH may be underestimated among Hispanics and overestimated among non-Hispanic whites. We support calls for systematic efforts to improve accurate and complete collection of race/ethnicity information (Geppert et al. 2004; Schoenman et al. 2005; Andrews 2015). Another limitation is that, in identifying PPHs, we excluded the discharges for out-of-state patients from each state; consequently, our estimates of PPH rates are likely to be under-estimates. To measure the scale of this under-estimation, we examined out-of-state hospitalizations in the 15 study states and found that the PPH rate in these states that were from out-of-state residents was small (3.0 percent). Another limitation is that all area-level measures used are at the county or state levels; this limitation arises from the absence of data at a finer

geographic area (e.g., zip code) from some states. To gain more granularity, we defined most measures by sociodemographic cohorts within the county. Social epidemiology indicates that in addition to individual SES factors, neighborhood SES factors influence individual health (Kawachi and Berkman 2003). As finer geographic units—census block, for instance—are more likely to capture individual differences in low-income and other socioeconomic vulnerabilities (Krieger et al. 2003), we recognize that use of county- and state-level measures in our study are more likely to be indicative of the influence of area-level (contextual) SES measures. This limitation of administrative discharge data in assessing the role of individual SES needs to be addressed by inclusion of patient-level measures.

CONCLUSIONS

Our findings suggest that, nationally, Hispanics have higher PPH rates. Virtually all of this disparity in these hospitalizations appears to be mediated by low income, lack of health insurance, and poorer provider availability. In comparison to Hispanics, blacks have even higher PPH rates, of which only a small portion is accounted for by the aforementioned mediators. Methodologically, our study also demonstrated a simple and transparent approach to developing a national database for studying health care utilization among Hispanics.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the supporting information tab for this article:

Appendix SA1: Author Matrix.

Appendix A: Development of the Near-National Inpatient Discharge Database.

Table A1. Proportion of National Population by Race/Ethnicity and State: Top Twenty States for Hispanic Population Census Population, 2010: Age 18+.

Table A2. Race/Ethnicity Reported in Raw Data Files, 2010–2011 State Inpatient Databases, Age 18+.

Table A3. Exclusion of Non-Community Hospitals.

Table A4. Exclusion of Hospitals with Suspect Race/Ethnicity Data 2010 and 2011: Age 18+.

Table A5. Exclusion of Discharges with Missing Key Fields (Age, Sex, and Zip Code or County Location), 2010 and 2011: Age 18+.

Table A6. Exclusion of Discharges from Out-of-State Residents 2010 and 2011: Age 18+.

Table A7. All Exclusions Combined.